

IN THE CLAIMS:

1.-22. (Cancelled).

23. (Currently Amended) A storage system, comprising:

a destination to store a ~~snapshot copy~~ from a source;

a first process to initiate a snapshot copy operation of the source, wherein the copy operation includes copying each block of the source to the destination, the snapshot copy operation being performed in segments, and each segment having being a snapshot range of data bytes of the source;

the storage system to receive a write request to modify a requested range of data bytes of the source while the copy operation is in progress, wherein the write request to modify the requested range of data bytes is a write request range;

the storage system to determine if the write request range of data bytes are falls within the snapshot-range of data bytes of the source being copied;

in response to determining that the write request range of data bytes are falls within in the snapshot-range of data bytes of the source being copied, the storage system to determine if the range of data bytes of the source have has been written to ~~the a~~ snapshot;

in response to determining that the range of data bytes of the source have has been written to the snapshot, the write request to be written to the source; and

in response to determining that the range of data bytes of the source have not been written to the snapshot, ~~the a second~~ process first to copy the range of data bytes of the source to the snapshot, and then the second process to write the write request to the source.

1 24. (Previously Presented) The storage system of claim 23, further comprising:

2 a RAID system.

1 25. (Currently Amended) The storage system of claim 23, further comprising:

2 ~~the range of the source specified by the snapshot is a first range, and the write re-~~
3 ~~quest specifies a second range of data bytes of the source; and~~

4 the storage system is operable, in response to receiving determining the write re-
5 quest range falls within the range of bytes being copied, the write request while the
6 source is being copied to the destination, to hold the write request in a cache, check if the
7 first range overlaps with the second range and, if so, copy the second range from the
8 source to the snapshot, and update a snapshot map, and then allow the write request to
9 write the source.

1 26. (Previously Presented) The storage system of claim 23, further comprising:

2 the process is executed on a file server.

1 27. (Previously Presented) The storage system of claim 26, further comprising:

2 the file server is connected to a storage area network switch and the file server
3 communicates with the storage system through the storage area network switch.

1 28. (Previously Presented) The storage system of claim 23, further comprising:

2 the process is operable to control multiple storage systems.

1 29. (Previously Presented) The storage system of claim 23, further comprising:

2 the write request includes SCSI commands.

1 30. (Currently Amended) The storage system of claim 23, further comprising:

2 the storage system is operable to send one or more commands by using ~~one of an~~
3 ~~in-band protocol or an out-of-band protocol.~~

1 31. (Currently Amended) A method comprising:

2 starting a ~~snapshot copy~~ command from a source to a destination wherein the
3 copy command copies each block of the source to the destination, the ~~snapshot copy~~
4 command being performed in segments and each segment specifying a ~~snapshot~~ range of
5 data bytes of the source;

6 ~~in response to receiving the snapshot command, taking a snapshot of the snapshot~~
7 ~~range using a command to control one or more devices on which the source is stored, the~~
8 ~~snapshot including a snapshot map and snapshot data;~~

9 receiving a write request to modify a requested range of data bytes of the source
10 while the copy command is in progress, wherein the write request to modify the re-
11 quested range of data bytes is a write request range;

12 determining if the write request range of data bytes are falls within the ~~snapshot~~
13 range of data bytes being of the source being copied;

14 determining, in response to the write request range of data bytes being in the
15 snapshot range of data bytes of the source being copied, if the range of data bytes of the
16 source has been written to ~~the a~~ snapshot;

17 writing, in response to the range of data bytes of the source having been written to
18 the snapshot, the write request to the source; and

19 copying, in response to the range of data bytes of the source having not been writ-
20 ten to the snapshot, the range of data bytes to the snapshot, and then writing the write re-
21 quest to the source.

1 32. (Previously Presented) The method of claim 31, further comprising:
2 using a RAID system as the source.

1 33. (Currently Amended) The method of claim 31, further comprising:
2 ~~receiving at the source the write request issued from a file system, the write re-~~
3 ~~quest specifying a first range of data bytes of the source, the write request being received~~
4 ~~while the source is being copied to the destination;~~

5 in response to determining the write request range falls within the range of data
6 bytes of the source being copied, receiving the write request, holding the write request
7 command in a cache, ~~checking if the first range overlaps with the range specified by the~~
8 ~~snapshot and, if so, copying the first range from the source to the snapshot, and updating~~
9 ~~the a snapshot map associated with the snapshot, and then allowing the write request to~~
10 ~~write to the source.~~

1 34. (Currently Amended) The method of claim 31, further comprising:
2 executing the ~~snapshot copy~~ command by a replication manager.

1 35. (Currently Amended) The method of claim 31, further comprising:
2 connecting a file server to a storage area network switch and the file server com-
3 municates with a storage system through the storage area network switch to execute the
4 ~~snapshot copy~~ command the storage system.

1 36. (Currently Amended) The method of claim 31, further comprising:
2 controlling multiple storage device controllers by a replication manager.

1 37. (Previously Presented) The method of claim 31, further comprising:
2 including a SCSI command in the write request.

1 38. (Previously Presented) The method of claim 31, further comprising:
2 sending a storage system commands using one of an in-band protocol or an out-
3 of-band protocol.

1 39. (Currently Amended) A computer-implemented method comprising:
2 starting a ~~snapshot~~ copy operation by copying data from a source to a destination,
3 the ~~snapshot~~ copy operation being performed in segments, and each segment having a
4 ~~snapshot~~ range of data bytes of the source;
5 receiving a write request to modify a requested range of data bytes of the source
6 while the copy operation is in progress, wherein the write request to modify the requested
7 range of data bytes is a write request range;
8 determining if the write request range of data bytes ~~is~~ falls within the snapshot
9 range of data bytes of the source being copied;
10 determining, in response to the write request range of data bytes ~~being~~ in the
11 snapshot range of data bytes of the source being copied, if the range of data bytes of the
12 source have ~~has~~ been written to the ~~a~~ snapshot;
13 writing, in response to the range of data bytes of the source having been written to
14 the snapshot, the write request to the source; and

15 copying, in response to the range of data bytes of the source not being written to
16 the snapshot, the range of data bytes of the source to the snapshot, and then writing the
17 write request to the source.

1 40. (Currently Amended) A system comprising:

2 a destination to store a ~~snapshot~~ copy from a source;

3 a first process to initiate a snapshot copy operation of the source wherein the copy
4 operation includes copying each block of the source to the destination, the snapshot copy
5 operation being performed in segments, and each segment having a snapshot-range of
6 data bytes of the source;

7 the system to receive a write request to modify a requested range of data bytes of
8 the source while the copy operation is in progress, wherein the write request to modify
9 the requested range of data bytes is a write request range;

10 the system to determine if the write request range of data bytes are falls within the
11 snapshot-range of data bytes of the source being copied;

12 in response to determining that the write request range of data bytes are falls
13 within in the snapshot-range of bytes of the source being copied, the system to determine
14 if the range of data bytes of the source have been written to the a snapshot;

15 in response to determining that the range of data bytes of the source have been
16 written to the snapshot, the write request to be written to the source; and

17 in response to determining that the range of data bytes of the source have not been
18 written to the snapshot, a second process to copy the range of data bytes of the source to
19 the snapshot, and then the second process to write the write request to the source.

1 41. (Previously Presented) The system of claim 40, further comprising:

2 the process is executed on a file server and is operable to control the source and
3 one or more other storage devices.

1 42. (Previously Presented) The system of claim 40, further comprising:
2 a list of source data blocks to be copied that are reordered to increase copy speed.

1 43. (Previously Presented) The system of claim 42, further comprising:
2 the list of blocks to be copied is buffered while the system awaits further copy
3 commands.

1 44. (Previously Presented) The system of claim 40, further comprising:
2 the process is operable to insert control data before and after a source data block
3 is copied.

1 45. (Previously Presented) The system of claim 40, further comprising:
2 the process is operable to specify a block size so that the storage system writes
3 fixed-size blocks.

1 46. (Currently Amended) A method, comprising:
2 receiving a write request while a copy operation is in progress wherein the copy
3 operation includes copying each block of the source to the destination, the copy operating
4 being performed in segments, and each segment has a range of data bytes of the source,
5 the write request to modify a requested range of data bytes in a source, wherein the write
6 request to modify the requested range of data bytes is a write request range;

determining if the write request range of bytes is falls within a the snapshot range
of bytes of the source being copied;

determining that the range of bytes of the source ~~has~~ have not been written to a
snapshot;

in response to determining that the range of bytes ~~has~~ have not been written to a
the snapshot, copying the range of bytes of from the source to the snapshot;

updating a snapshot map, wherein the snapshot map indicates which blocks are
located in the snapshot; and

modifying the range of bytes of data in the source from the write request.

47. (Currently Amended) The storage system of claims 23, further comprising:

the write request being placed in a first in first out queue in response to determin-
ing that the range of data bytes have not been written to the snapshot.

48. (Currently Amended) The ~~system method~~ of claims 31, further comprising:

placing the write request in a first in first out queue in response to determining
that the range of data bytes have not been written to the snapshot.

49. (Currently Amended) A computer-readable storage media comprising instructions for
execution in a processor for the practice of a method of operating a server comprising:

receiving at ~~the a~~ source ~~the a~~ write request issued from a file system, the write
request specifying a first range of data bytes of the source, the write request being re-
ceived while the source is being copied to ~~the a~~ destination; and

in response to receiving the write request, holding the write request ~~command~~ in a
cache, checking if the first range overlaps with the range specified by the a second range
wherein the second range is a range of data bytes of the source being copied to the desti-
nations snapshot and, if so, copying the first-second range from the source to the snapshot,
updating ~~the a~~ snapshot map, and then allowing the write request to write to the source.

1 50. (New) A method for making a copy of data in a database, comprising:

2 starting a copying operation of a source to a destination, wherein the copy opera-
3 tion is performed in segments and each segment is a range of data bytes of the source, the
4 copy operation started at a begin time;

5 maintaining a snapshot volume that includes each block of the source that has a
6 write request directed to that block during the course of the copy operation;

7 receiving a write request directed to the range of data bytes being currently copied
8 to the destination;

9 in response to determining that the range of bytes have not been copied to the
10 snapshot volume, holding the write request until the range of bytes are copied to the
11 snapshot volume;

12 after completion of writing the range of bytes to the snapshot volume, executing
13 the write request on the source to update the source with a changed data; and

14 copying the snapshot volume to the destination in order to maintain a copy of a
15 data on the destination as the data existed on the source at the begin time.

1 51. (New) A system to make a copy of data in a database, comprising:

2 a process executing on a processor of the system to initiate a copy operation of a
3 source to a destination, wherein the copy operation is performed in segments and each
4 segment is a range of data bytes of the source, the copy operation started at a begin time;

5 the system to maintain a snapshot volume that includes each block of the source
6 that has a write request directed to that block during the course of the copy operation;

7 the system to receive a write request directed to the range of data bytes being cur-
8 rently copied to the destination;

9 in response to determining that the range of bytes have not been copied to the
10 snapshot volume, the system to hold the write request until the range of bytes are copied
11 to the snapshot volume;

12 after completion of writing the range of bytes to the snapshot volume, the system
13 to execute the write request on the source to update the source with a changed data; and

14 copying the snapshot volume to the destination in order to maintain a copy of a
15 data on the destination as the data existed on the source at the begin time.

1 52. (New) A computer-readable storage media comprising instructions for execution in a
2 processor for the practice of a method of operating a server comprising:
3 starting a copying operation of a source to a destination, wherein the copy opera-
4 tion is performed in segments and each segment is a range of data bytes of the source, the
5 copy operation started at a begin time;
6 maintaining a snapshot volume that includes each block of the source that has a
7 write request directed to that block during the course of the copy operation;
8 receiving a write request directed to the range of data bytes being currently copied
9 to the destination;
10 in response to determining that the range of bytes have not been copied to the
11 snapshot volume, holding the write request until the range of bytes are copied to the
12 snapshot volume;
13 after completion of writing the range of bytes to the snapshot volume, executing
14 the write request on the source to update the source with a changed data; and
15 copying the snapshot volume to the destination in order to maintain a copy of a
16 data on the destination as the data existed on the source at the begin time.

1 53. (New) The storage system of claim 23, further comprising:
2 the storage system is operable to send one or more commands by using an out-
3 band protocol.

1 54. (New) The method of claim 31, further comprising:
2 in response to determining that the write request range does not fall within the
3 range of data bytes of the source being copied, determining if the write request range is
4 directed to a range of data bytes that have not yet been copied; and

5 in response to determining that the write request range is directed to the range of
6 data bytes that have not yet been copied to the snapshot, copying, the range of bytes not
7 yet copied, to the snapshot.